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ABSTRACT

A study examined the effect of three different prereading vocabulary development strategies on sixth grade science test results. Subjects, 81 sixth-grade students from a suburban, middle-class school in Union County, New Jersey, were divided into four heterogeneous science classes and given a pretest of 40 vocabulary words taken from the science textbook. Three of the four classes were guided in instructional prereading vocabulary development while the fourth group was given no prereading vocabulary treatment. One of the three experimental groups was taught vocabulary using the glossary strategy; another group used the context clue method; and the last group used the semantic mapping strategy. After approximately 4 weeks of study, the students were given the same vocabulary test. Results indicated no significant difference in test scores among the four groups. Results of the pretest indicated that the four groups were not equivalent in ability as previously thought based on random assignment to treatment samples. (Seven tables of data are included; the vocabulary test is attached.) (RS)

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The Effect of Pre-reading Vocabulary Development Strategies on Sixth Grade Science Test Results

by

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Abstract

The purpose of this study was to determine the effect of prereading vocabulary development strategies using three different approaches, on sixth grade science test results.

A pretest of forty vocabulary words taken from the science textbook within the chapter on biomes was given to the eighty students who had previously been divided into what was thought to be four heterogeneous samples. Mean scores were calculated for each sample. When teaching of the chapter was begun, one of the four samples became the control sample and was given no prereading vocabulary treatment. The other three samples became the experimental samples. One of these was taught vocabulary using the glossary strategy; another sample was taught vocabulary using the context clue method and the fourth sample was taught vocabulary by the semantic mapping strategy. After approximately four weeks of study the students were given the same vocabulary test.

A t test of mean scores of the pre-test showed that the samples were not equivalent in ability as previously thought based on random assignment to treatment samples. Gain scores were then calculated. Results of the t test of mean gain scores showed that

prereading strategies using glossary, context clues or semantic mapping does not result in higher sixth grade test scores on chapter tests in the science content area.

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The failure of teachers to improve vocabulary means that students will slide "more deeply into the abyss of school failure daily. With this slide comes a school psychologist's book full of attendant problems: poor self-esteem, no motivation, inability to orient oneself toward school success, text anxiety and hostility toward authority" (Sharp, 1989).

The purpose of teaching in all the content subjects is comprehension and concept acquisition. Teachers must realize that the first step in teaching is vocabulary development through planned and direct instruction (Roe, 1987). A.V. Mazo and J.K. Shirk say that vocabulary is an important means by which we learn, "that is to say, vocabulary is central to concept formation, acculturation, articulation, and apparently, all learning" (Mazo, 1971). According to Edgar Dale, in order to know a content subject one must learn its key concepts, that is, its language (Dale, 1971).

Reading difficulties in the intermediate grades affords the interested researcher the opportunity for studies to determine the degree to which students understand the vocabulary in the content areas. In these grades "pupils seem to have considerable difficulty comprehending reading materials in the social studies and science" (Johnson, 1952). Even though Mary Johnson's study in 1952 may seem outdated today, her results stand firm.

In table IX, the Relative Order of Difficulty of Subject Matter Areas, she reports that in science only 38.64 percent of the words tested were correct. The final outcome of that study showed that vocabulary development "is needed for the understanding of the textbooks used in the content subjects" (Johnson, 1952).

Since related research indicates that word enrichment is important, the teacher is faced with the problem of developing a program that adequately prepares the student for the understanding of the content subject. One such approach that teachers have used is the simple glossary method. Even though it may seem an antiquated method, it must be defended merely on the grounds that it incorporated the tactile kinesthetic input. Its use, however, to be efficient, assumes on the part of the intermediate student, a knowledge of alphabetical order beyond the first letter of the word and the use of guide words (Roe, 1987). A teacher must select this approach with caution.

Another vocabulary development approach is the use of context clues. Numerous studies have been done on this approach and according to Nagy, Anderson, and Herman, previous research provided "a shaky basis for determining the amount of learning from context that actually takes place during

normal reading" (Nagy, 1987). They found in their study of 352 students in the third, fifth and seventh grades that small but reliable gains in knowledge from either expository or narrative passages were found at all grade and ability levels when using context as a method of gaining vocabulary knowledge.

A third approach, a graphic one known as semantic mapping, "has been used successfully by teachers at all levels to motivate and actively involve learners in the thinking-reading-writing processes" (Johnson, 1986). In Johnson's survey of 228 first grade through fifth grade elementary school teachers from seven areas of the United States ninty-nine percent of the teachers said that they use semantic mapping to teach vocabulary as part of content area instruction.

Related research then, supports the hypothesis that vocabulary instruction is necessary for all students and especially for middle school students if they are expected to process the materials found in content subjects. Working with narrative text of basal readers is not particularly useful in helping students deal with their core curriculum (Sharp, 1989). In the area of science this holds true because vocabulary may take the form of three categories:

general, specific or technical. To teach the concepts involved in the content materials, teachers must select a vocabulary development approach that reaches all students whether that approach be a glossary, context clues or semantic mapping approach (Ekwall, 1988).

While various approaches for vocabulary development have been validated, all too often content area teachers, especially science teachers, place too little emphasis on preparing students adequately for unfamiliar reading and concepts through vocabulary development. The ultimate goal of all reading is comprehension and without thorough vocabulary preparation, students at all levels will flounder. This holds true for all elementary and intermediate grades and in particular, for sixth graders who come to start a middle school with high expectations of learning new science concepts on a level higher than previously taught. If science vocabulary, before content reading, is not taught, students will very quickly lose interest in the content material, start a chain reaction of poor test results, and ultimately "turn off" to science.

Hypothesis

To add to the body of information available to the

teacher, the following study was undertaken. It was hypothesized that teacher-guided vocabulary development, as a pre-reading strategy using glossary, context clues or semantic mapping, would not result in higher sixth grade test scores on chapter tests in the science content area.

Methods and Procedures

Eighty-one sixth grade students from a suburban, middle-class, middle school in Union County, New Jersey, were divided into four heterogeneous science classes. Three of the four classes were guided in instructional pre-reading vocabulary development. One group was taught new vocabulary by the independent use of the glossary and dictionary. A second group was guided to learn new vocabulary using context clues. The third group learned new vocabulary through the semantic mapping technique. The fourth group was the control group and was given no pre-reading vocabulary instruction.

Each group was given a pre-reading test on forty vocabulary words that would later be used within the new chapter. This tested comprehension and concepts from background and experience. Mean scores and standard

deviations were obtained for each of the samples. Pre-reading instruction began the day after the pre-test, followed by content reading. At the end of the chapter of about twenty pages, a post-test was given using the same vocabulary measure of text comprehension of concepts after reading and instruction. Mean scores and standard deviations of the four samples were then calculated. Finally, a t test of mean gain differences of the four samples was obtained and examined to test the hypothesis.

Results

As can be seen on the pre-test Tables I, II, and III there was a seven point difference in mean scores between the control and glossary samples in favor of glossary with the difference being non-significant; there was a nine point

Table I

	M	SD	T
Control	42.53	15.81	1.12
Glossary	49.00	19.55	

N.S

Table II

	M	SD	T
Control	42.53	15.81	- 3.74
Context	64.39	19.61	

S. $<$.01

Table III

	M	SD	T
Control	42.53	15.81	2.01
Semantic Mapping	51.70	14.15	

S. $<$ 05

difference in mean scores between the control and semantic mapping samples in favor of semantic mapping indicating a significance below the .05 level and a difference of twenty-two points in mean scores between the control and context samples indicating a high significance below the .01 level. These differences indicate that the samples were not equivalent at the outset of the study.

As noted in post-test tables IV, V, and VI, there are only modest differences between the mean scores of the samples at the conclusion of the study, a one point difference

between the means of the control and glossary samples, a seven point difference in means between the control and context samples, and a four point spread in mean scores

Table IV

	M	SD	T
Control	78.16	23.71	.13
Glossary	77.65	19.68	

N.S.

Table V

	M	SD	T
Control	78.16	23.71	- 1.00
Context	85.00	17.05	

N.S

Table VI

	M	SD	T
Control	78.15	23.71	- .63
Semantic Mapping	82.00	16.47	

N.S.

of the control and semantic mapping samples. None of these differences were significant levels though marked gains from the pre to the post test were made. Since the samples were not equivalent according to the pre-test results, gain scores were computed to determine the difference, if any.

Table VII details those results and shows that a five

Table VII

Gain Scores of the Samples

	M	SD	T
Control	35.63	23.59	.84
Glossary	30.21	15.10	
N.S.			
Control	35.63	23.59	2.39
Context	20.61	12.64	
S. < .05			
Control	35.63	23.59	1.06
Semantic Mapping	29.88	11.08	
N.S.			

point difference in the mean scores between the control and glossary samples exists but the difference is not significant with thirty-six degrees of freedom. The fifteen point mean score difference between the control and context samples results in t score of 2.39 indicating a significant difference $<.05$ in favor of the control population with thirty-five degrees of freedom. The comparison of the control sample and the semantic mapping sample shows a six point mean score difference resulting in no significance with forty-one degrees of freedom.

Conclusions

The only significant difference in sample gain scores after the three vocabulary treatments, glossary, context, and semantic mapping, were administered showed up in the comparison of the control versus the context samples with the significance of $<.05$ in favor of the control samples. On the basis of this, one could conclude that the context technique of teaching vocabulary development results in a negative factor. However, close scrutiny of the pre-test scores indicates that the context sample performed, at the beginning of the experiment, at a very much higher level

than the control sample. Because of this, it may be concluded that the context sample already had, for various reasons, some of which could be higher I.Q.'s, more experiential background, better teachers, or parental attitudes and values that favored education, known the greater portion of vocabulary words before the teaching began. The context sample therefore, had the possibility of relatively little gain from the start.

Because there was no significant difference in vocabulary gain between the control and glossary as well as between the control and semantic samples, it can be concluded that students were able to learn concepts and comprehend material in this content area without any vocabulary treatment at all because the porportion of new vocabulary was not great enough to present a formidable obstacle nor were the new words on a level of difficulty that could not be learned within the context of the reading. It should also be noted though in this study context gain scores were significantly lower than glossary and semantic mapping samples, context pre-reading vocabulary treatment is not necessarily a limiting factor.

The t test of mean gain scores resulted in an affirmation of the hypothesis that teacher-guided vocabulary development

as a pre-reading strategy using glossary, context clues or semantic mapping would not result in higher sixth grade test scores on chapter tests in the science content area.

Implications

Vocabulary is an important factor in learning from all reading and especially in the content areas. Overall gains are made, which result in concept learning, even though specific vocabulary treatment before reading, whether glossary, context or semantic mapping, may not be necessary on a sixth grade level in science in a middle-class, middle school, suburban population.

Vocabulary Development: Related Research

To produce a literate population is the goal of educators even though that goal is not always reached. In today's society an unacceptable number of students fall into the category of "educationally at risk." For these students, vocabulary deficiency is a foreboding obstacle. Therefore, increasing vocabulary knowledge is a "fundamental part of the process of education" (Nagy, 1988). If teachers expect to realize their goal and improve comprehension in all areas and especially in the content area (Nelson-Herber, 1986), it is extremely important that they understand why, when and how to use intensive vocabulary activities more effectively and to realize that reading with comprehension involves generative cognitive processes, the major components of which are generation, motivation and attention. Through these processes meaning is created by building relations between the text and what is known, believed, and experienced. A teacher is the instrument through which students come to realize these processes (Wittrock, 1983). Robert Ruddell (1986) says "establishing motivation and desire to acquire new vocabulary is at the very heart of vocabulary acquisition."

Vocabulary knowledge is the basis for reading comprehension as one cannot understand the concepts in

text if the degree of unknown words is too great. The relation between vocabulary and comprehension has been documented in a myriad of research studies for over a half century (Johnson, D. et al,1936). As early as Hilliard's study in 1924, the relationship has been defined.

In 1981 Anderson and Freebody reported that the proportion of difficult words in text is the most significant factor in predicting text difficulty and a student's general vocabulary knowledge is the "best predictor of how well that reader can understand text" (Anderson and Freebody, 1981). It would seem then, that all teachers have to do is to teach students more words and almost automatically the students will achieve success in reading. This is unfortunately an over-simplistic deduction. According to several research studies, in fact, vocabulary instruction failed to increase text comprehension.

Nagy (1988) states that educators may well find this news disturbing because the number one motive for teaching vocabulary prior to reading is to help students understand material they are about to read. He is of the firm opinion that if traditional instruction is not producing the desired effect "teachers should know why

not, and what to do about it." More research is needed and new methods of vocabulary instruction continue to be developed.

There are two primary reasons why some vocabulary instruction fails to enhance comprehension. The first is that in-depth word knowledge is not achieved. A number of studies indicate that a student requires a level of word knowledge higher than that achieved through many types of vocabulary instruction. The conclusion is that teachers should augment instruction with more intensive methods to produce "richer, deeper word knowledge" (Nagy, 1988). The second reason for comprehension failure due to inadequate vocabulary instruction is the readability of texts containing unfamiliar words in a proportion of more than one in six. If the proportion is less than one in six, then students do not need more vocabulary instruction but simply more reading. Nagy and associates have done several studies that confirm that view. A similar study of magnitude was done by Freebody and Anderson in 1983 which concluded that "one content word in six could be replaced by a more difficult synonym without significantly decreasing comprehension of a text." In this study it was found that students will comprehend

through context when rare words are kept at less than one substance word in six. Also tested in this study was the effect of vocabulary difficulty on three measures of text comprehension: free recall, summarization and sentence recognition. The result was that the greatest difficulty was in total sentence recognition (Freebody and Anderson, 1983).

Research has indicated that there are major problems with traditional methods of vocabulary instruction. The definitional approach, looking up words in a glossary or dictionary, writing them down and memorizing them is probably the one most used by teachers. Another method is the contextual approach, inferring the meaning of a new word from context. Neither method, however, taken by itself, is especially effective at improving reading comprehension (Nagy, 1988).

The most common vocabulary instructional approach, the definitional one, has its "better and worse versions and one should not conclude that definitions are not useful in vocabulary instruction. But definitions alone can bring the student to only a relatively superficial level of word knowledge. By itself, looking up words in a dictionary or memorizing definitions does not reliably

improve reading comprehension" (Nagy, 1988). First of all, many definitions are made up of words less likely to be known by the reader than the word being looked up. For example, the word "image" was defined as "likeness", a relatively rare word, occurring less than twice in a million words of text (Carroll et al, 1971). Secondly, definitions are often not directly appropriate to the text being read, or if appropriate, often does not allow the person to use the word correctly because of insufficient information. This point is clearly proven in activities created for teachers by John Sheffelbine (1984). If adults find it difficult, then the "problem is especially acute for children who are less able to use the information that is available in definitions" (Miller & Gildea, 1987). Definitions may well be deficient in conveying new concepts. The point is that definitions must play an important part in vocabulary instruction. Researchers agree however, that the definitional approach must be intensified with yet further instruction in order to allow the student to conceptualize the word.

Another common vocabulary instructional strategy is the use of context. When using this method a teacher will ask the student to figure out a word meaning by

using clues from the other words or adjacent sentences. This strategy is important for students to learn for use on their own, but teachers must face up to the problem that again, context approaches alone often do not result in concept development so necessary for reading comprehension because it gives only a limited amount of information (Deighton, 1959). Shatz and Baldwin (1986) conducted three studies and found that "in none of the three experiments was there any statistically significant effect due to context." Good context clues may be helpful to the student who already has some knowledge of the word but teachers who insist on using this strategy in isolation of others must be prepared "to accept partial word knowledge, some degree of uncertainty and occasionally misleading contexts" (Beck et al, 1983). Joan Gipe (1980), in her study of four vocabulary teaching methods, association, category, context and dictionary, says "when instructional strategies make provisions for relating new information to old, as in the case of the context method used in this study, understanding takes place." Her conclusion was based on the following means of fifth grade poor readers in the four methods: association method, 4.10; category method, 3.74; context method, 5.46; and

dictionary method, 3.63. Other researchers are not as certain about the context method. Joseph Jenkins et al (1989) concluded from reviewing several studies which addressed the question of incidental vocabulary learning from reading that "together, these studies indicate that students 'can' learn word meanings from context, but the probability that they actually will learn a word meaning from context is low." Again, context clue strategies are good tools but most often will require supplemental information if a good grasp on a new word is to be realized.

Combining the definitional and contextual approach would then seem to be the answer and most teachers would say that they do, in effect, combine the two strategies. Why then, the difficulty with text comprehension? According to Nagy (1988) "it would be safe to say that good definitions and contexts are a minimal requirement for good instruction, but they by no means exhaust what can be put into a good vocabulary lesson." Eileen Carr (1986) says "what is clear is that not all of the procedures used to teach vocabulary are equally effective."

Methods referred to as intensive vocabulary instruction (Stahl, 1986; Graves & Prenn, 1986; Carr &

Wixson, 1986) do contain the three properties of vocabulary instruction that are effective in increasing reading comprehension: integration, repetition and meaningful use. One such intensive vocabulary instructional strategy is called "semantic mapping".

This strategy has been the focus of detailed research by Dale Johnson and his collegues (1982). "Effective vocabulary instruction integrates new information with familiar information; semantic mapping and similar techniques illustrate ways this can be done. Effective vocabulary instruction also should establish connections among the instructed items" (Nagy, 1988). Semantic mapping has also been the subject of a study by Carol Margosein et al (1982) which concluded that semantic mapping instructional strategies result in higher vocabulary test scores than context clue instruction alone.

Stahl (1986) reviewed 52 vocabulary instruction studies and concluded that "over the long term, children taught word meanings significantly outperformed children not given instruction, indicating that sustained attention to vocabulary may produce better comprehension. Not all types of vocabulary instruction produced these effects, though." Related research

indicates that vocabulary development is important but must be conducted within the framework of an approach that will give the student the greatest opportunity for reading comprehension and the degree of literacy so necessary in today's world.

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Appendix

Vocabulary List

region	swarm	survive
biosphere	solar	prevent
climate	hibernate	shrubs
tundra	cattails	desert
permafrost	taiga	scarce
graze	tropical	available
prairie	surface	deciduous
organism	biome	shallow
sphere	burrow	harsh
range	lichens	migrate
adaptation	precipitation	coniferous
musk ox	meadow	invade
hatch	narrow	hare
coniferous forests		

Select from the vocabulary list, the word or phrase that fits the definition

1. _____ A living thing.
2. _____ The upper portion of or the part that is visible.
3. _____ The earth's life sphere.
4. _____ A circle.
5. _____ Opposite of wide.
6. _____ Having to do with the sun.
7. _____ Can be had.

8. _____ Region of the earth where many of the same kinds of plants and animals live.

9. _____ Average weather for a large region over a long period of time.

10. _____ A place or area.

11. _____ Amount of water that falls.

12. _____ Means from the lowest to the highest or vice versa.

13. _____ Means to be able to live.

14. _____ Means severe; not pleasant.

15. _____ Not in great abundance.

16. _____ Any structure that helps an animal to survive.

17. _____ Means to dig under.

18. _____ An animal of a very cold region that has heavy fur.

19. _____ The region of the earth where it is extremely cold and has low vegetation.

20. _____ A common plant of the northern-most regions of the earth.

21. _____ Means to break out of eggs.

22. _____ Name for large amounts of insects that fly together.

23. _____ Means to move to a different area in order to survive.

24. _____ Permanently frozen ground.

25. _____ The name of the largest biome on this earth.

26. _____ Trees that produce seeds in cones.

27. _____ Means to keep from doing something.

28. _____ An area that is mostly grass surrounded by an area of trees.

29. _____ Means to eat low grasses.

30. _____ A very deep sleep in which some animals spend the winter.

31. _____ A certain kind of rabbit.

32. _____ Means to drop leaves.

33. _____ Green plants that are higher than grasses but smaller than trees.

34. _____ The regions of the earth where conifer trees are most abundant.

35. _____ Warm and wet.

36. _____ Another name for the grassland area.

37. _____ A plant that grows widely in the grassland biome.

38. _____ A region that receives little or no rain.

39. _____ Means to take over an area.

40. _____ Means not deep.